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IS 8365 (1991): Copper alloys for spot and seam resistance welding electrodes [MTD 8: Copper and Copper Alloys]



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ताँबा मिश्र धातुएँ

(पहला पुनरीक्षण)

Indian Standard

COPPER ALLOYS FOR SPOT AND SEAM
RESISTANCE WELDING ELECTRODES

(*First Revision*)

UDC 621.791.763.1.042 : 669.35

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FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Copper and Copper Alloys Sectional Committee had been approved by the Metallurgical Engineering Division Council.

Copper is the basis of all spot welding electrodes because of its high electrical and thermal conductivity. High conductivity hard-drawn copper has a conductivity of over 90 percent of International Annealed Copper Standard (IACS) and is used in the welding of materials of high electrical conductivity such as aluminium and its alloys. The addition of a small percentage of cadmium increases, without much loss of conductivity, the softening temperature of the alloy which is greater than that could be obtained with pure copper. Copper-zirconium is a cost effective substitute for copper-cadmium as it has a higher softening point. Chromium-copper containing chromium may be hardened by heat-treatment and cold working and is one of the resistant to wear and to softening at elevated temperatures than any materials for spot-welding electrodes. Copper-nickel-phosphorus, copper-cobalt-beryllium and copper-nickel-beryllium have high strength with moderate conductivity and are used for stainless and heat resistance steel welding. Some of the applications for which these electrodes are used are given in Annex A.

This standard was first published in 1977. In the present revision following are main modifications:

- a) The scope has been enlarged to cover the requirements of 5 additional copper alloys suitable for spot and seam resistance welding electrodes;
- b) Terminology has been aligned with IS 3288 (Part 3) : 1986;
- c) Mercurous nitrate test has been added;
- d) A new clause on 'References' has been added; and
- e) The copper alloys for spot and seam resistance welding electrodes have been categorized in 3 grades depending upon applications.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (revised)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

COPPER ALLOYS FOR SPOT AND SEAM RESISTANCE WELDING ELECTRODES

(*First Revision*)

1 SCOPE

This standard covers the requirements for copper alloys for spot and seam resistance welding electrodes.

2 REFERENCES

The following Indian Standards are necessary adjuncts to this standard:

<i>IS No.</i>	<i>Title</i>
1387 : 1967	General requirements for the supply of metallurgical materials (<i>first revision</i>)
1501 (Part 1) : 1984	Method for vickers hardness test for metallic materials; Part 1 HV 5 to HV 100 (<i>second revision</i>)
1501 (Part 2) : 1984	Method for vickers hardness test for metallic materials; Part 2 HV 0.2 to less than HV 5 (<i>second revision</i>)
2305 : 1988	Method for mercurous nitrate test for copper and copper alloys (<i>first revision</i>)
2826 : 1986	Dimensions and tolerance for wrought copper and copper alloy rods and bars for general engineering purposes (<i>third revision</i>)
3186 : 1965	Method for chemical analysis of cadmium copper
3288 (Part 3) : 1986	Glossary of terms for copper and copper alloys : Part 3 Wrought form
9861 : 1961	Dimensions for wrought copper and copper alloy wires for general engineering purposes

3 TERMINOLOGY

3.0 For the purpose of this standard, the following definitions as given in IS 3288 (Part 3) : 1986 shall apply.

3.1 Bar/Rod

A solid wrought product of uniform cross section along its whole length, supplied in straight length or coil form, whose width or greatest distance between parallel faces is greater than 6 mm.

3.2 Wire

A solid section of uniform cross section along its whole length and the distance between two parallel faces not exceeding 6 mm, may be supplied in straight length or in coils or in spools.

4 SUPPLY OF MATERIAL

General requirements relating to the supply of material shall be as laid down in IS 1387 : 1967.

5 FREEDOM FROM DEFECTS

The materials shall be clean, smooth, sound and free from harmful defects.

6 DIMENSIONS AND TOLERANCES

6.1 The diameter of the wire/bar shall be as required by the purchaser and stated in the order.

6.2 The tolerances on the diameter of wire/bar shall be in accordance with IS 9861 : 1981/ IS 2826 : 1986.

6.3 Where the tolerances other than those specified in **6.2** are required, these shall be subject to agreement between the purchaser and the supplier and shall be stated in the order.

7 CHEMICAL COMPOSITION

7.1 If required, the chemical compositions of the material shall be as specified in Table 1.

7.2 The chemical composition of cadmium-copper shall be determined either by the method specified in IS 3186 : 1965 or any other established instrumental/chemical method. In case of dispute the procedure specified in IS 3186 : 1965 shall be the referee method.

Table 1 Chemical Composition

(Clause 7.1)

Grade	Alloy	Cd	Cr	Zr	Co	Ni	Be	P	Impurities Max	Cu
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
I	a) Cu-Cd	0.3 to 0.7	—	—	—	—	—	—	0.1	Remainder
	b) Cu-Zr	—	—	0.05 to 0.15	—	—	—	—	0.1	„
II	a) Cu-Cr	—	0.5 to 1.2	—	—	—	—	—	0.2	„
	b) Cu-Cr-Zr	—	0.5 to 1.2	0.05 to 0.15	—	—	—	—	0.2	„
III	a) Cu-Ni-P	—	—	—	—	0.8 to 1.2	—	0.10 to 0.15	0.05	„
	b) Cu-Co-Be	—	—	—	2.0 to 2.8	—	0.4 to 0.7	—	0.2	„
	c) Cu-Ni-Be	—	—	—	—	2.0 to 2.8	0.4 to 0.7	—	0.2	„

7.3 For chemical analysis of copper-zirconium, Grade II and Grade III alloys, the method of analysis shall be as agreed between the supplier and the purchaser.

8 PHYSICAL PROPERTIES

8.1 Hardness

The material shall have the hardness as specified in Table 2. Hardness shall be determined in accordance with IS 1501 (Part 1) : 1984 and IS 1501 (Part 2) : 1984.

8.2 Special Softening Test for Chromium Copper

The whole electrode or a piece cut out from it shall be soaked for 60 minutes in an electric furnace or oven at a temperature of 400°C and then taken out from the furnace or oven and cooled in air and tested for hardness. This hardness figures should not be less than the minimum stipulated in the specification for the particular product.

8.3 The values of electrical conductivity and softening temperature are given in Table 2 for guidance.

9 MERCUROUS NITRATE TEST

9.1 The material shall be subject to mercurous nitrate test as specified in IS 2305 : 1988.

9.2 There shall be no crack in the specimen when examined immediately after the test specimen is removed from the solution, rinsed with water and wiped off.

10 SAMPLING AND CRITERIA FOR CONFORMITY

10.0 Unless otherwise agreed to between the purchaser and the supplier, the following sampling procedure and criteria for conformity shall hold good.

10.1 Lot

In any consignment all the materials of same size, grade and condition, manufactured from the same raw material, produced at the same place shall be grouped together to constitute a lot. However, a lot shall not exceed 1 000 kg in mass. If necessary two or more lots shall be formed on the basis of the mass of the consignment.

10.2 Each coil/bundle shall be examined for the freedom from defects and for tolerances on diameter. Any coil/bundle found defective shall be rejected.

10.3 From the coil/bundles found satisfactory in 10.2, one sample per 1 000 kg or part thereof in the lot shall be selected and tested for chemical composition, hardness and mercurous nitrate test. For this purpose the coils, from which samples are cut, shall be selected at random.

10.3.1 If the test results of chemical analysis as obtained for each of the constituent satisfy the corresponding requirements the lot shall be considered as conforming to the chemical composition requirements of this standard.

Table 2 Physical Properties(*Clauses 8.1 and 8.3*)

Grade	Material	Condition	Hardness, HV,			*Electrical Conductivity % IACS	*Softening Temperature °C
			Up to 25 mm	25 to 50 mm	Over 50 mm		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
			<i>Min</i>	<i>Min</i>	<i>Min</i>	<i>Min</i>	
I	a) Cu-Cd	Cold drawn	120	110	95	80	275°C
	b) Cu-Zr	Cold drawn	120	110	95	85	475°C
II	a) Cu-Cr	Heat treated	130	120	110	75	500°C
	b) Cu-Cr-Zr	„	130	120	100	75	525°C
III	a) Cu-Ni-P	„	150	140	130	50	475°C
	b) Cu-Co-Be	„	200	200	200	45	500°C
	c) Cu-Ni-Be	„	200	200	200	45	500°C

*For information only.

NOTE — Castings may have 5 HV less hardness.

10.3.2 If the test results satisfy the corresponding requirements of (hardness test) and mercurous nitrate test the lot shall be considered as conforming to that requirements of this specification.

10.4 Retest

10.4.1 If a test result of chemical analysis fail to satisfy the requirements for any of the constituents, two more tests for that constituent shall be done on the same sample in order to confirm that the analysis has been done properly. If both the test results satisfy the relevant requirements, the lot shall be considered as conforming to the specification, otherwise not.

10.4.2 If any of the test sample first selected fail to pass the hardness test and mercurous nitrate test, two further samples from the same lot shall be selected and tested for that test, one of which shall be from the coil/bundle from which original test sample was taken,

unless that coil/bundle has been withdrawn by the supplier.

10.4.3 If both the additional samples pass that test, the lot represented by the test sample shall be deemed to comply with this standard. If either of these additional samples fail, the lot shall be rejected.

11 PACKING

This material shall be suitably packed to avoid damage during transit or as required by the purchaser.

12 MARKING

12.1 Suitable tags with marking made on them to show size, grade, condition and mass of material, lot number, date of manufacture, in addition to the name of manufacture and any other information required by the purchaser, shall be attached to each coil/bundle of material.

12.2 The material may also be marked with the Standard Mark.

ANNEX A

(Foreword)

APPLICATIONS OF COPPER ALLOYS FOR RESISTANCE WELDING ELECTRODES

A-1 APPLICATIONS FOR GRADE I ELECTRODES

A-1.1 Cadmium-copper and zirconium-copper are used very successfully for spot welding electrodes, seam welding wheels, and structural parts in welding machines. It is recommended specifically for spot and seam welding of the following materials:

- a) Aluminium and its alloys,
- b) Magnesium and magnesium alloys,
- c) Tin plate,
- d) Terne plate,
- e) Chrome Plate,
- f) Galvanized iron, and
- g) Other coated materials.

A-2 APPLICATION FOR GRADE II AND III

A-2.1 Chromium-copper is used extensively for spot welding electrodes, flash welding dies and seam welding wheels, and provides better performance and greater savings than other copper alloys used for spot and seam welding of the following materials:

- a) Cold-rolled steel;

- b) Hot-rolled steel (clean, pickled);
- c) Nickel-plated steel;
- d) Nickel alloys and monel metal;
- e) Silicon bronze type alloys; and
- f) Nickel silver.

A-2.2 Chromium-copper in wrought and cast shapes is used in numerous applications where a high strength, high conductivity material is required as a structural member.

Examples:

Arms for gun welders, current carrying parts for circuit breakers, backing for circuit breaker arcing contacts, and bridging contact backings in heavy duty relays.

A-2.3 Copper-nickel-phosphorus is having similar hardness as copper-chromium but has considerably better creep and fatigue properties.

A-2.3.1 Copper-cobalt-beryllium and copper-nickel-beryllium are fused for spot and seam welding of stainless steel and heat resistance steels. It is recommended for butt welding and flash welding blocks, projection welding electrodes, hot rivetting dies.

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